

Patent Application of

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For

TITLE: OILFIELD TOOL HEATING ELEMENT IN LINE

CROSS-REFERENCE TO RELATED APPLICATIONS

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BACKGROUND--FIELD OF INVENTION

This invention relates to raising the temperature of crude oil or petroleum products as it passes through the production tubing, flow lines or field lines to prevent or eliminate paraffin or paraffin-like deposits in the piping systems.

BACKGROUND--DESCRIPTION OF PRIOR ART

From the beginning of crude oil discovery and production one of the most expensive problems producers have encountered is the build up of paraffin and paraffin-like deposits in the production tubing, flow lines and field lines. It is not uncommon that the flow of oil from a well is completely stopped due to paraffin deposition. Furthermore, deposition of paraffin and paraffin-like deposits in flow lines and field lines also result in completely clogged pipes. This results in increased pumping and


maintenance cost for the producer. This problem continues today because all previous efforts related to paraffin problems have been methods of treating the paraffin deposition after it occurs. No prior effort has been directed towards the prevention of paraffin deposits in the production tubing, flow lines or field lines. All prior art referred to below is directed towards dissolving the paraffin deposits after solidification occurs.

The need to prevent or eliminate paraffin deposits from piping systems utilized in the production and transportation of crude oil is obvious. In some areas, wells decline in productivity at a more or less rapid rate because of the deposition of such deposits in the piping systems. Pipe capacities are frequently reduced to a small fraction of their capacities. Ultimately, such pipes may be found completely clogged by paraffin deposits.

Various techniques have been employed for the removal of paraffin residue in production tubing, flow lines and field lines. One such method is hot oil treatment. This method utilizes steam pumped under great pressure between the casing and tubing. The pressure applied during this process forces paraffin residue into the producing formation. The effects of the pressure on the producing zone results in clogged perforations and ultimately decline or loss of production. The hot oil method is time consuming, requires down time to perform, is expensive and bears great risks.

Additionally, another method commonly used in the oil industry to treat paraffin deposition requires stopping production, the cost of a rig to retrieve the tubing, steam or scrap the inner wall to remove the deposits and then replacing the tubing strand back into the well. This is also a very time consuming and costly procedure that fails to prevent paraffin deposition in the pipes, and merely maintains the problem. The risk of loss of production while the well is shut-in, coupled with the maintenance expense renders many wells unprofitable to produce.

Solvents are another method of treating paraffin problems. There has been limited success with the use of solvents through the years. The varying composition of crude oil from one zone to another as



well as one well to another limited the effectiveness of solvents . The process of using solvents is expensive as well as experimental from one well to the next, as each well requires a different combination of chemicals . Although solvents are a chemical treatment, I reference it as prior art because the process is paraffin treatment related.

Inventors have also attempted a combination of heat and chemicals to treat paraffin deposition. The below list of patents and references cited is voluminous but includes all various methods discussed above for the treatment of paraffin in oil wells. However, none of the prior arts referenced prevent the deposition of paraffin in the piping systems of the oil industry. All referenced prior arts are attempts at treating or cleaning up the solidified paraffin once it occurs.

References cited: U.S. Patent Documents 47,410 to Fraser (1865), 231,287 to Digman et al (1880), 457,457 to Robison et al (1891), 522,737 to Lucock (1894), 573,142 to Flanegin (1896), 762,628 to Gardner (1904), 766,313 to Yoast (1904), 780,279 to Gardner (1905), 784,454 to Waring (1905), 884,424 to Seymour et al (1908), 972,308 to Williamson (1910), 1,082,971 to Pick (1913), 1,095,365 to Williamson (1914), 1,169,262 to Huff (1916), 1,232,736 to Truman et al (1920), 1,360,404 to Hollister et al (1920), 1,368,404 to Loftus (1921), 1,383,670 to Stephens (1921), 1,426,407 to Pennington (1922), 1,450,658 to Warnick (1923), 1,457,690 to Brine (1923), 1,464,618 to Pershing (1923), 1,477,802 to Beck (1923), 1,504,208 to Brine (1924), 1,540,648 to Pershing (1925), 1,646,599 to Schaefer (1927), 1,672,200 to Buck (1928), 1,690,994 to Powell (1928), 1,701,884 to Hogle (1929), 1,761,227 to Pasley (1930), 1,776,997 to Downey (1930), 1,839,632 to Agnew (1932), 2,202,034 to Thomas (1940), 2,208,087 to Somers (1940), 2,244,256 to Looman (1941), 2,260,916 to Rial (1941), 2,332,708 to Freeman (1943), 2,484,063 to Ackley (1949), 2,500,305 to Ackley (1950), 2,632,836 to Ackley (1953), 2,660,249 to Jakosky (1953), 2,666,487 to Bowman (1954), 2,685,930 to Albaugh (1954), 2,808,110 to Spitz (1957), 2,836,248 to Covington (1958), 2,998,066 to Nixon, Sr. (1961), 3,163,745 to Boston (1964), 3,279,541 to Knox et al (1966), 3,410,347 to Triplett et al (1968), 3,437,146 to Everhart et al (1969), 3,614,986 to Gill (1971), 3,828,161 to Yamaguchi (1974), 3,943,330 to Pollock et al (1976), 4,026,358 to Allen (1977), 4,178,993 to Richardson et al

(1979), 4,219,083 to Richardson et al (1980), 4,285,401 to Erickson (1981), 4,330,037 to Richardson et al (1982), 4,399,868 to Richardson et al (1983), 4,790,375 to Bridges (1988), 4,911,239 to Winckler et al (1990), 5,120,935 to Nenninger (1992), 5,247,994 to Nenninger (1993), 5,282,263 to Nenninger (1994), 5,400,430 to Nenninger (1995).

Foreign Patent Documents: 1,182,392 CA. (1985), 2,504,187 to FR. (1982), 1,298,354 to SU. (1987), 8,810,356 to WO. (1988).

Other References:

Nenninger et al, "Optimizing Hot Oiling/Watering Jobs to Minimize Formation Damage", Petro. Society of CIM/Soc. Of Petro Eng, 1990.

Nelson et al, "Oil Recovery By Thermal Methods", Pt. 11, the petroleum engineer, Feb., 1959.

"High Temperature Thermal Techniques for Stimulating Oil Recovery", P.D. White et al, J. of Petro. Technology, pp. 1007-1011, Sep., 1965.

R. Van A. Mills The Paraffin Problem in Oil Wells Dec. 1923.

John Power Removing Paraffin Deposits from Wells with Electric Heater 1928.

L. G. E. Bignell Electric Heaters Remove Paraffin Nov 14, 1929.

Frank V. Eaton Applications of Heat Increases Production in Wyoming Field Apr. 22, 1943

H. E. Allen and R. K. Davis "Electric Formation Heaters and Their Application" Apr. 1954.

K. G. Parrent "Bottom Hole Heaters" May 1970.

World Oil "AC Current Heats Heavy Oil for Extra Recovery" May 1970.

Dr. S. M. Faroug Ali "Well Stimulation by Downhole Thermal Methods" Oct. 1973.

D. L. Currans "Electroflood Proves Technically Feasible" Jan. 1980

Edward T. Yukl & Andrew W. Marr, Jr. "process Solves Paraffin Buildup in Tubing" Aug. 8, 1988.

Petrotherm Electric Bottom-Hole Heating System.

All of these methods have had minimal success in addressing the paraffin problem in wells for a number of reasons. First, pressured fluids introduced into the production zone or formation carry a risk

of clogging the perforations and reducing the production of the well. Secondly, none of the above heater designs can be integrated as part of the production tubing, thus disallowing the ability to produce while the heater is in use. There are designs of heaters that can be placed in the producing zone that allow for production to continue while in use, however these heaters can not heat the oil to a degree that will allow the oil to reach the surface before cooling and the production tubing becoming clogged. In addition the placement of a heater below the production pump heats the gases that naturally occur in petroleum products and result in the pump becoming gas locked. When the down hole pump becomes gas locked, the well must be turned off for a period of time to allow the gas to move past the pump, freeing it to function again.

SUMMARY:

The present invention will revolutionize the oil production industry. It is the first preventative approach offered to oil producers. The ability to provide precise placement of the invention permanently into the piping system, whether in the production tubing, flow lines or field lines is a first. This allows the producer to supply heat to the crude oil in the areas that the actual cooling occurs, thus eliminating the ability of the paraffin to solidify and clog the pipes.

OBJECTS AND ADVANTAGES:

Accordingly, several objects and advantages of my invention are:

- (a) to provide a heat source directly in the tubing line at any point where the paraffin begins to solidify
- (b) to provide a versatile heat source that can be placed at any point in the flow lines and or field lines as needed to prevent cooling of oil and paraffin clogging
- (c) the invention is not restricted to use in the production zone
- (d) provide heat source to both flowing and pumping well, as normal pumping methods can be used through the invention

- (e) prevents interference with the down hole pump due to gas lock from heated gas
- (f) greatly reduces the need for hot oil services
- (g) greatly reduces the need for chemical treatment of the oil
- (h) reduces the need to pull the well for the purpose of cleaning clogged pipes, thus reducing down time and lose of production
- (i) reduces risk of loss of production due to pressuring chemicals or steam into the perforations
- (j) provides a continuously clean production tubing, flow line or field line, allowing for maximum flow and production through these lines.

In accordance with the flexibility of my invention direct application of heat where it is needed is allowed. This provides producers of crude oil the ability to produce wells more cost effectively. Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

DRAWING FIGURES

Fig. 1 shows three views of heating apparatus, front view, right side view and end view.

Fig 2 shows a broken view of heating apparatus.

Fig 3 shows a view in section of a portion of the roof strata, showing the apparatus of the present invention installed as a section of the production tubing strand in an oil well.

REFERENCE NUMERALS IN DRAWINGS

10 heating apparatus

11 hollow inner core

12 plurality of holes; perforations

13 threaded coupling

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| 14 threaded coupling | 15 suitable closure member (washer) |
| 16 suitable closure member (washer) | 17 suitable closure member (washer) |
| 18 heat source | 19 electric power supply or steam line |
| 20 conduit | 21 baffle |
| 22 heat source termination | 23 heated fluid chamber |
| 24 moisture free zone (termination area) | 25 outer case |
| 26 outer case | 27 tapered cap |
| 28 tapered cap | 29 inlet plug |
| 30 outlet plug | 31 slot or opening |
| 32 sucker rod | 33 power or steam source |

DESCRIPTION--FIGS. 1 THROUGH FIG 3 PREFERRED EMBODIMENT

Referring to the embodiment shown in Fig 1 through Fig 3, like numerals indicate like parts throughout the several views. My heating apparatus 10 comprises an inner hollow cylindrical tube 11. Tube 11 is of predetermined dimensions, threaded at each end (not shown) and comprises a plurality of holes or perforations 12. Perforations 12 are arranged in space relation along tube 11. Tube 11 in combination with threaded couplings 13 and 14 comprise a continuous inner core of predetermined

dimensions. Couplings 13 and 14, and tube 11 are of suitable material and specifications to allow my heating apparatus 10 to be integrated into the production tubing, flow lines or field lines in the oil production industry.

Suitable closure members 15, 16 and 17, resembling large washers, are attached by welding or other appropriate means at predetermined intervals along tube 11. Washers 15 and 16 having a plurality of holes as needed to allow for heat source 18 termination and electrical or steam supply 19 access. As indicated in Fig 2 of the drawings the heat source 18 terminations or leads 22 pass through suitable openings in washer 15 and are sealed by appropriate means. Washer 15 is attached above the perforated section of tube 11. Washer 16 is attached to tube 11 above washer 15 and comprises suitable openings which allow for conduits 20, compatible with electrical or steam energy source 19 to be installed and sealed.

In the preferred embodiment baffle(s) 21 are placed at predetermined intervals to tube 11 and appropriately secured. Baffle(s) 21 support and space heat source 18 along tube 11. Near the lower end of tube 11, washer 17 is placed just below the perforations 12. Washer 17 is appropriately secured to tube 11 and sealed. Washers 15, 16 and 17 in combination will create a series of chambers 23 and 24, along tube 11.

The heat source 18 passes through washer 15, terminates 22 and seals as needed to satisfy the heat source 18 requirements. There are a variety of options for heat source 18 that can be utilized.

Between washer 15 and 16 a suitable source of electrical or steam energy 19, which may be employed for the supply of electrical current or steam, to the heat source 18, are connected to the leads or terminations 22 of heat source 18. In this connection, it is pointed out, all electrical wiring and connections are to be flash ignition proof and properly insulated.

Outer cases 25 and 26 are of a material appropriate for use in the oil industry. Outer case 25 is

properly secured and sealed to washers 17 and 15 forming sealed chamber 23. Chamber 23 encapsulates heat source 18 and the perforated section of tube 11.

Outer case 26 is secured and sealed to washers 15, 16 and outer case 25 forming a sealed chamber 24. Chamber 24 is a moisture proof chamber encapsulating the terminal where the heat source and energy supply source connect. Chamber 24 is to be flushed of all oxygen by nitrogen replacement when electrical energy is utilized. Plugs 29 and 30 provide inlets and outlets for this process.

My heating apparatus has tapered caps 27 and 28 interconnected to outer case 25 and 26. Cap 27 comprises a slot or opening 31 of predetermined size allowing passage of any suitable electrical or steam energy supply source 19. Cap 27 is interconnected with case 26, washer 16 and coupling 13 by welding or other suitable means. Cap 28 is interconnected to case 25, washer 17 and coupling 14 in a like manner as cap 27. Caps 27 and 28 are configured in a tapered manner to allow easy entrance and exit in the casing when my heating apparatus 10 is incorporated into the production tubing strand.

In Fig 3 heating apparatus 10 is incorporated into the production tubing. The sucker rod 32 passes through the heating apparatus. The electrical or steam supply line 19 is attached to heating apparatus 10 and the main supply source above ground 33.

ADVANTAGES

From the description above, a number of advantages of my heating apparatus become evident:

- (a) constant heat can be supplied to the production fluid without interruption of production.
- (b) heating apparatus can be incorporated anywhere in the production tubing, flow line or field lines as is needed
- (c) production by means of pumping jack with rods can operate normally through the heating

apparatus

(d) downtime for maintenance or well due to paraffin treatment is reduced to minimal

(e) use of chemical treatments reduced to minimal

(f) use of heating apparatus results in a continuously clean piping system by preventing deposition of paraffin in the trouble areas.

(g) allows for maximum production by minimizing clogging of production tubing, flow lines and field lines.

OPERATON--FIGS 1, 2 AND 3

It may now be appreciated how my heating apparatus 10 may be employed. Prior to employing the preferred method of preventing the build up of paraffin and paraffin-like deposits in the production tubing, flow lines and field lines , all prior attempts were to treat deposits after they occurred. By incorporating my heating apparatus 10 into the production tubing, flow lines or field lines minimal, in any, deposits will occur.

The manner of using the in line heating apparatus in the production tubing line is to pull the existing tubing strand, by usual means practiced in the oil industry. Locate the area in the tubing strand that exhibits paraffin or paraffin-like deposits. These deposits indicate where in the tubing line oil begins to cool , thus resulting in paraffin solidification.

When returning the tubing strand to the production hole, my heating apparatus 10 should replace a joint of tubing at a point just below the noted paraffin deposits. My heating apparatus is designed in such a manner as to allow normal integration into the tubing strand by means

of the threaded couplings 13 and 14 located at each end of the apparatus.

The electrical or steam supply source 19 is connected to the heating apparatus 10 before it is lowered into the production hole, and the line is fed into the well as the tubing and heating apparatus 10 are replaced. The electrical or steam supply line 19 is periodically secured to the tubing strand in a manner which is practiced in the petroleum industry.

Once the tubing strand has been fully restored, the electrical or steam supply source 19 is connected to a switchbox or steam supply pump 33 located on the surface.

Normal production of the well resumes, either flowing or pumping. The popular means of pumping by use of a pumping jack, sucker rods and down hole pump can be employed with my preferred embodiment because it allow the sucker rod 32 to operate through my heating apparatus 10 as shown in Fig 3.

The oil well is put back into operation, by pumping or flowing. A flow meter (not shown) at the wellhead is used to monitor the flow of fluids form the well. When a sufficient flow is reached and the tubing is noted to be fluid filled the electrical power or steam supply source 19 and 33 to the heating apparatus 10 is engaged.

Normal pressure and movement of the fluid in the production tubing as it moves through my heating apparatus 10 forces the fluid through the perforations 12 of the inner core 11 and into chamber 23. Here the production fluid moves through chamber 23 and is making contact with the heat source 18. The fluid moves upward through chamber 23, circulating through the perforations 12, and exiting tube 11 at the top. During the period the fluid was moving through heating apparatus 10 the temperature was raised by contact with the heat source. This raise in temperature keeps the paraffin suspended in the oil. As the fluid continues through the production tubing to the surface, the increased temperature achieved by contact with my heating apparatus prevents paraffin and paraffin-like deposits from

occurring in the tubing.

When incorporating my heating apparatus 10 into the flow or field lines, it is best to locate the trouble areas in the existing line and replace the joint just prior to the clogged joint. Adding the heating apparatus just prior to the previous trouble spots increases the temperature of the fluid before the paraffin begins to solidify and clog the lines minimizing the chance of any future deposits.

CONCLUSIONS, RAMIFICATIONS AND SCOPE

Accordingly, the reader will appreciate that maintaining fluid temperature as it travels from the production zone to the surface is the only means of preventing paraffin solidification. My heating apparatus provides the heat source where it is needed with a constant heat while production occurs. Furthermore, the heating apparatus offers additional advantages in that

- It permits the heating apparatus to be installed during regular maintenance of the well, eliminating the expense of pulling the well exclusively to install the apparatus
- It allows the well to be produced without the expense of treatment chemicals
- It provides a way to produce the well without the downtime and expense of hot oil services
- It prevents the risk of paraffin and paraffin-like deposits from ever forming in the production tubing, flow lines or field lines
- Reduces risk of loss of production due to downtime to treat paraffin deposits
- Reduces risk of loss of production caused by other treatment methods that result in clogged perforations

- It provides a cost effective means of preventing paraffin deposition in the production tubing, flow lines and field lines.

Although the description above contains many specifications, these should not be construed as limiting the scope of the invention, but as merely providing illustrations of some of the presently preferred embodiments of this invention. Various modifications will be apparent to and can be readily made by those skilled in the art to which the invention pertains without departing from the spirit and scope of the invention.

Accordingly, the scope of the invention and its method should be determined not by the embodiment(s) illustrated, but by the appended claims and their equivalents.